Natural Fracture Exploration

Identification of Fracture Induced Anisotropy in Tight Gas Sands Using Multiple Azimuth 3-D Seismic Data Attributes

San Juan Basin, New Mexico

GeoSpectrum, Inc

Objective

- **The objective of this project is to demonstrate the methodology of applying modern seismic processing techniques, followed by a rigorous seismic attribute analysis, for detecting and quantifying areas of high natural fracture density that are likely to lead to commercial gas production from low permeability "tight" gas formations.**

Goals

- to demonstrate a methodology with strong near-term commercialization potential for detecting and quantifying areas of high natural fracture density that is likely to lead to commercial gas production from low permeability “tight” gas formations
- to verify the presence and quantity of predicted natural fractures by drilling and testing a verification well(s)
- to demonstrate the technology in the Dakota Formation of the San Juan Basin, an area of favorable gas production potential from tight gas sands

Available Data

- Burlington Resources P-wave 3-D seismic data volume
- Well data, including Formation Micro-Imaging Logs
- Core analysis data
- Aeromagnetic data
- Gravity data
- Satellite imaging data

Data Information

- **3-D Seismic Volume**
  - Size of field data — 9.1 gb
  - Number of shots — 600
  - Number of receivers — 1800 (live)
  - Trace length — 4.0 sec/2ms
  - Data Organization — 32 bit floating
- **Stacked Data**
  - 9 sq. mile and 110 ft X 110 ft bins
  - 212 inlines
  - 205 crosslines
  - 348 Mb stacked volume

Base Program

- **TASK I - DATA ACQUISITION**
  - Subtask 1.1 Software, Hardware Considerations for Analysis of Data
  - Subtask 1.2 Acquire the Seismic Data for the Analysis (P-wave 3-D seismic data)
  - Subtask 1.3 Acquire Well Data, Core Analyses, Gravity, Aeromagnetic, and Satellite Image Data

Base Program

- **TASK 2 - PROCESSING AND DATA ANALYSIS**
  - Subtask 2.1 Database Construction
  - Subtask 2.2 Initial 3-D Seismic Interpretation and Geostatistics
  - Subtask 2.3 Fracture Interpretation of FMI Logs and Core
  - Subtask 2.4 Azimuthal Dependent Seismic Data Processing
  - Subtask 2.5 3-D Seismic Analysis of Fractured Induced Anisotropy and Geostatistics
  - Subtask 2.6 Amplitude Variations with Offset Modeling and Interpretation
  - Subtask 2.7 Site Selection and Verification Well Plan

Decision

- **At the completion of Task 2, a technical review meeting will be held between DOE, GeoSpectrum, and Burlington Resources**

- **A determination will be made on drilling the verification well and to mutually agree upon the well site location.**

Option Program

- **TASK 3 -- DRILLING AND TESTING OF VERIFICATION WELL**
  - Subtask 3.1 Drill Well
  - Subtask 3.2 Testing of Well
- **TASK 4 -- Post Mortem and Technology Transfer**
  - Subtask 4.1 Quantify the Natural Fracture Network and Well Potential
  - Subtask 4.2 Technology Transfer

Milestones

- **Task 1.0 Data Acquisition**
  - Subtask 1.1 3/14/2000
  - Subtask 1.2 3/30/2000
  - Subtask 1.3 5/29/2000
- **Task 2.0 Data Processing & Analysis**
  - Subtask 2.1 7/10/2000
  - Subtask 2.2 10/10/2000
  - Subtask 2.3 9/22/2000
  - Subtask 2.4 11/29/2000
  - Subtask 2.5 3/09/2001
  - Subtask 2.6 3/19/2001
  - Subtask 2.7 4/12/2001

Milestones (Cont.)

- **Task 3.0 Drilling and Testing of Verification Well**
  - Subtask 3.1 7/18/2001
  - Subtask 3.2 8/21/2001
- **Task 4.0 Post Mortem and Technology Transfer**
  - Subtask 4.1 10/26/2001
  - Subtask 4.2 2/13/2002

Deliverables

- **CD-ROM of digital database (the digital database will be generic in regard to location)**
- **Verification Well Plan**
- **Best Practice Manual**